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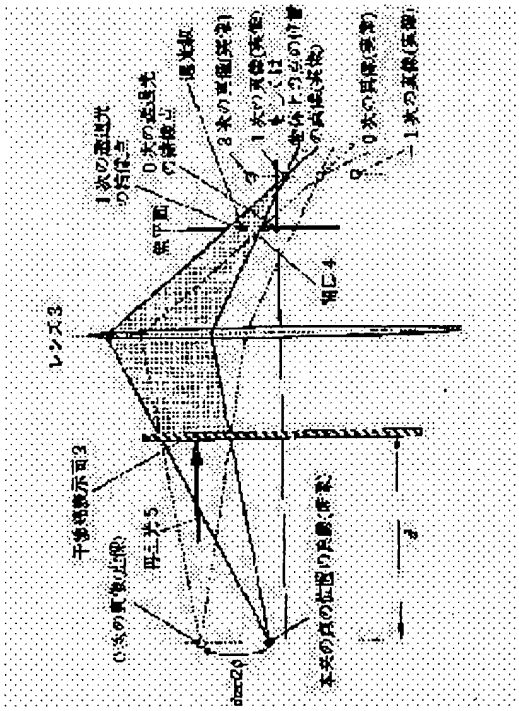
(71)Applicant : NIPPON HOSO KYOKAI <NHK>

(72)Inventor : MISHINA TOMOYUKI
OKANO FUMIO

(54) THREE-DIMENSIONAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To enlarge a visual area by using light which participates with the high-order image formation as to an apparent image reproduced from interference fringes in the case of forming a hologram image again, and also, arranging an aperture for forming only the high-order apparent image reproduced from the interference fringes equivalent to the apparent image positioned at a point on the original object on the image side focal plane of a lens.



SOLUTION: The three-dimensional display device is provided with an interference fringe display screen 2 with a sampling structure for displaying the interference fringes, reproduction light 5 for reproducing object light from the interference fringes and the lens 3 for forming the hologram image again from the reproduced object light. In the case of forming the hologram image again, the light which participates with the high-order image of the apparent image reproduced from the interference fringes is used, and also, the aperture 4 for forming only the high-order apparent image reproduced from the interference fringes equivalent to the apparent image positioned at the point on the original object is arranged on the image side focal plane of the lens 3. Thus, the hologram image having a wide visual area is reproduced.

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the three dimentional display equipment which realized expansion of a viewing area while being equipped with the interference fringe screen which has the sampling structure which starts the three dimentional display equipment using a computer generated hologram, especially displays an interference fringe.
[0002]
[Description of the Prior Art] While displaying by turns two kinds of interference fringes created by the half zone plate method, this invention persons By performing closing motion of two shutters formed in opening installed in the image side focal plane of a re-image formation lens synchronizing with the display of an interference fringe The conjugate image which is that view ** of a true image is blocked, the transmitted light, and the high order image generated when the interference fringe screen has sampling structure were removed, and the three dimentional display equipment which made it possible to expand a viewing area was already invented (Japanese Patent Application No. No. 81680 [ten to]).
[0003] As mentioned above, although this three dimentional display equipment (Japanese-Patent-Application-No. No. 81680 [ten to] specification publication) realizes expansion of a viewing area, it makes it requirements to have removed beams of light other than the light which participates in the image formation of a true image there so that view ** of a true image may not be barred.
[0004]
[Problem(s) to be Solved by the Invention] However, in invention given in a Japanese-Patent-Application-No. No. 81680 [ten to] specification, since only the beam of light which participates in the image formation of the reproduced true image was used, the maximum of the expanded viewing area was restricted to the value decided by resolution of the interference fringe screen. When putting in another way, there was a fault that a viewing area was unexpandable more than the viewing area restricted by the sampling interval of the interference fringe screen. [0005] The purpose of this invention is in three dimentional display equipment equipped with the interference fringe screen which has the sampling structure which displays an interference fringe to offer the three dimentional display equipment which is not restricted to the value it is decided in the resolution of the interference fringe screen that the maximum of the viewing area expanded like the above (Japanese Patent Application No. No. 81680 [ten to]) will be.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention three dimentional display equipment In the three dimentional display equipment equipped with the interference fringe screen which has the sampling structure which displays an interference fringe, the playback light to which it acts as the recurrence student of the body light from said interference fringe, and the lens to which re-image formation of the hologram image is carried out from this body light that acted as the recurrence student at least While using the beam of light which participates in the image formation of the high order image of the true image reproduced from an interference fringe in carrying

out re-image formation of said hologram image It is characterized by coming to arrange opening for carrying out image formation only of the high order true image reproduced from said interference fringe equivalent to the true image of the location of the point on an original body to the image side focal plane of said lens.

[0007] Moreover, this invention three dimentional display equipment is characterized by switching the location of said opening arranged to the image side focal plane of said lens synchronizing with this switch corresponding to said switched interference fringe while it switches the interference fringe which participates in the image formation of the zero-order and high order image displayed on the interference fringe screen by time sharing.

[0008] Moreover, this invention three dimentional display equipment is equipped with two or more three dimentional display equipments which have at least opening arranged in the image side focal plane of an interference fringe display, a lens, and said lens for carrying out image formation of the zero-order or high order image, and is characterized by compounding on space the light reproduced from each of these three dimentional display equipment.

[0009]

[Embodiment of the Invention] With reference to an accompanying drawing, this invention is explained at a detail based on the gestalt of implementation of invention below. Before starting explanation of this invention, the range where body light spreads as conditions for the interference fringe displayed on the interference fringe screen which has sampling structure not to contain a component by return is explained.

[0010] Interference fringes are stripes produced by making body light and a reference beam interfere. The period of these stripes is decided by the include angle which the travelling direction of body light and the travelling direction of a reference beam make, and if this include angle becomes large, the period of an interference fringe will become small. Therefore, if the sampling interval of the interference fringe screen is decided, the minimum period of the stripes displayed on the interference fringe screen will be decided, and the maximum of the include angle which the body light of interference fringe creation time and a reference beam make is decided. When the include angle which body light and a reference beam make exceeds maximum, as a result of the period of an interference fringe becoming small across a display limitation, a right interference fringe will not be able to be displayed on the interference fringe screen, but the interference fringe which broke and returned will be displayed.

[0011] Drawing 1 shows the range where the body light from which the interference fringe which does not contain a clinch component is obtained spreads. In addition, drawing 1 shows the case where a reference beam carries out incidence in the direction of a normal of the interference fringe creation side 1. Moreover, although drawing 1 is shown within the vertical plane including the point on a body as an example, there is this [no] and it can consider a field difference the same way in every field.

[0012] In drawing 1 , both the maximum include angles phi of the include angle which the body light decided by the sampling interval p of the interference fringe creation side 1 and a reference beam make will be set to phi**lambda / 2p, if wavelength of body light and a reference beam is set to lambda. Body light not to include a component in the interference fringe generated by interfering with a reference beam in the interference fringe creation side 1 among the beams of light generated from the point on a body by return The include angle of it and a reference beam to make the include angle at which the travelling direction of the range below phi, i.e., body light, and a reference beam crosses the direction of a normal of an interference fringe creation side, respectively thetaO and thetaR If it is (However, make a drawing top counterclockwise rotation forward and thetaO and thetaR are taken as the range which fills sin thetaO **thetaO and sin theta R**theta R, respectively), it is include-angle thetaO. It is necessary to satisfy formula phi>=|thetaR-thetaO |. In addition, in the case of drawing 1 , it is include-angle thetaR. It is thetaR =0.

[0013] It sets to this invention and is include-angle thetaR of a reference beam. Include-angle thetaO set to |thetaR-thetaO |>phi which a component produces by return in an interference fringe when fixed In order to reproduce the range of the body light which it has, the light which participates in the image formation of the high order image of the true image reproduced from the interference fringe which was

made to move a body location and was created is used.
[0014] Drawing 2 (a) and (b) as 1st operation gestalt of this invention three dimentional display equipment Include-angle thetaR of the travelling direction of a reference beam, and the direction of a normal of the interference fringe creation side 1 to make thetaR =thetaR0 (thetaR0 is constant value) When it carries out Include-angle thetaO used as phi<=theta O-thetaR0 <=3phi generated from the point on a body Playback of the body light which it has is shown.,
[0015] In drawing 2 (a) and (b), it is shown by the top view in a vertical plane including an optical axis, a body exists in a vertical plane, and this operation gestalt is the case where the include angle thetaR0 of a reference beam and the direction of a normal of the interference fringe creation side 1 to make is thetaR0=0. Hereafter, although explained within a vertical plane based on drawing 2 (a) and (b), it can think the same way in a horizontal plane. What is necessary is to divide into the direction of a vertical, and a horizontal direction, and just to consider on space, the body which exists in the location of arbitration.
[0016] In drawing 2 (a), distance between the point on a body and the interference fringe creation side 1 is set to d. Distance with the interference fringe creation side 1 here by d From the location of the point on a body, in the direction of a vertical And dsin 2 phi**dtan The case where a hologram image is reproduced with the playback light 5 of the same include angle as the reference beam of thetaR =thetaR0 from the interference fringe which was created with the reference beam of thetaR =thetaR0 and a body light of |thetaR-thetaO |<=phi within the limits and which does not have a component by return is considered about the point of a location which left only 2phi.
[0017] If this hologram image will be called for convenience zero-order true image (virtual image) as shown in drawing 2 (b), image formation of the light from this zero-order true image (virtual image) will be carried out to the location of a zero-order true image (real image) through the path shown with a broken line with a lens 3. Furthermore, although the high order image to a zero-order true image (real image) is generated in coincidence from the interference fringe screen 2 having sampling structure If a number will be numbered and said in an order from zero-order, using vertical above as forward for this high order image for convenience To the light which participates in the image formation of a true image zero-order in the travelling direction of the light which participates in the image formation of a high order image (a degree is set to n), only an include angle theta inclines and the include angle theta is set to theta**sin theta=n lambda/p =2nphi (n= **1, **2, and ...).
[0018] Therefore, as the light (light of the range which gave shading in drawing 2 (b)) which participates in the image formation of the primary anti-logarithm (real image) has the beam of light which participates in the image formation of a zero-order true image (real image), and the include angle which 2phi makes and it is shown in drawing 2 (b) The light of the image formation location of the primary true image (real image) of phi<=theta O-thetaR0 <=3phi from the true image (virtual image) equivalent to the location of the point on a body corresponds with the location of the real image by which image formation was carried out with the lens 3.
[0019] Drawing 3 shows that the matter about the 1st operation gestalt mentioned above is materialized about the point of the arbitration on a body. drawing 3 -- setting -- the distance from the interference fringe screen -- respectively -- dA and dB point A' which exists in the location which separated only dA tan2phi and dB tan2phi from the points A and B which are two on a body in the direction of a vertical, respectively, and B -- ' ******** -- the interference fringe which does not have a component by return with the reference beam of thetaR =thetaR0 and a body light of |thetaR-thetaO |<=phi within the limits is created. When this interference fringe was displayed on the interference fringe screen 2 and a hologram image is reproduced with the playback light 5 of the same include angle as the reference beam of thetaR =thetaR0, point A' and B' -- the beam of light (among drawing 3) which participates in the image formation of each zero-order true image (real image) The beam of light of the range shown with the broken line is point A' and B'. Since it has include-angle 2phi made to the beam of light (beam of light of the range which gave shading among drawing 3) which participates in the image formation of each primary true image (real image), respectively, Include-angle thetaO used as phi<=theta O-thetaR0 <=3phi generated from each point A and B It turns out that it becomes the body light which it has, and

equivalence.
[0020] The point on a body is dsin 2 phi**dtan to the direction of a vertical from an original location in the interference fringe creation time from the above thing. After assuming that it is what exists in the location from which only 2phi was separated If the interference fringe which does not have a component by return with the reference beam of thetaR =thetaR0 and a body light of |thetaR-thetaO |<=phi within the limits is created and a hologram image is reproduced from the created interference fringe with the playback light 5 of the same include angle as the reference beam of thetaR =thetaR0 The light which participates in the image formation of the primary true image (real image) of the reconstruction image is include-angle thetaO used as phi<=theta O-thetaR0 <=3phi generated from the location of the point on an original body. It becomes the body light and equivalence which it has. The range where the body light to the whole body spreads using the light which participates in the image formation of a high order image is expandable by performing same processing on a computer and creating an interference fringe about all the points on a body.
[0021] Namely, include-angle thetaO set to phi<=theta (2n-1) O-thetaR0 <=(2n+1) phi generated from the point on a body About the body light which it has From the location of original [point / on a body] to dsin 2n phi**dtan After assuming that it is what exists in the location from which only 2nphi was separated, the interference fringe which was created with the reference beam of thetaR =thetaR0 and a body light of |thetaR-thetaO |<=phi within the limits and which does not have a component by return is created. If this interference fringe is reproduced with the playback light 5 of the same include angle as the reference beam of thetaR =thetaR0, image formation of the light from the true image (virtual image) by which the n-th image of the true image (real image) by which image formation was carried out is equivalent to the location of the point on an original body will be carried out to the location of the true image (real image) by which image formation was carried out with the lens 3. The beam of light which participates in the image formation of this true image (real image) is include-angle thetaO used as phi<=theta (2n-1) O-thetaR0 <=(2n+1) phi. It becomes the body light and equivalence which it has.
[0022] The above explanation is include-angle thetaO used as phi<=theta (2n-1) O-thetaR0 <=(2n+1) phi generated from the point on the body light which spreads in a reverse side, i.e., the body in n< 0. It is applicable also about the body light which it has. As mentioned above, include-angle thetaO used as |thetaR-thetaO |>phi which a component produces by return in an interference fringe with the beam of light which participates in the image formation of the high order image of the true image reproduced from the interference fringe which was made to move a body location and was created The body light which it has is reproducible.
[0023] Here, in order to expand a viewing area using the beam of light which participates in the image formation of a high order true image, an unnecessary beam of light must be eliminated. With reference to drawing 4 and drawing 5 , it explains below how an unnecessary beam of light is eliminated. Drawing 4 shows the method of exclusion of an unnecessary beam of light. If the opening 4 which lets the beam of light of the range which gave shading pass is arranged to the image side focal plane of a lens 3 as shown in drawing 4 , image formation only of the high order true image (real image) reproduced from the interference fringe equivalent to the primary true image (real image), i.e., the true image of the location of the point on an original body, can be carried out. The field where the light (light of the range which gave shading) which participates in the image formation of the primary true image (real image) in drawing 3 crosses a focal plane does not call at the location of the point on a body, but even if the configuration and location of this opening 4 also change the location of the true image (real image) by which image formation is carried out, they are eternal so that uniformly.
[0024] Drawing 5 (a) and (b) show the magnitude, configuration, and location of the above-mentioned opening 4. As shown in drawing 5 (a), the sampling interval of the interference fringe screen 2 is level pH, It has the square array of Perpendicular pV, Supposing the focal distance of a lens 3 is f It is level lambdaf/pH as it is shown in drawing 5 (b), while the image formation point (image formation point of the zero-order transmitted light) of the direct transmitted light of the playback light 5 exists in an image side focal plane, Perpendicular lambdaf/pV The image formation point of the high order transmitted light will exist at spacing. This high order image formation location of the transmitted light, It is the

image formation location drawn from the Fourier transform of the sampling structure of drawing 5 (a). Moreover, the field of the square surrounded the repeat period of the high order image shown with the slash focusing on the image formation point of the zero-order transmitted light in drawing 5 (b) is a passage field of zero-order light.

[0025] In reproducing only a zero-order true image (real image), it arranges to an image side focal plane by using the passage field of this zero-order light as opening. Similarly, in reproducing only the n-th true image (real image), it arranges opening of the same magnitude as the passage field of zero-order light to an image side focal plane focusing on the image formation point of the n-th transmitted light. Therefore, the configuration of the opening 4 for reproducing the primary true image in drawing 4 (b) (real image), i.e., the true image over the point on an original body, (real image) becomes the part of void shown in drawing 5 (b). Moreover, in order to shade the image formation point of the transmitted light for every opening in this case, it is necessary to arrange a small gobo to the core of opening.

[0026] When it used for the transmitted light and the Japanese-Patent-Application-No. No. 81680 [ten to] specification from which a conjugate image is removed concerning this invention persons' invention at the 1st operation gestalt of this invention explained above combining the technique of a publication, after removing active jamming by the transmitted light and the light which participates in the image formation of a conjugate image, the body light which was not reproduced is reproducible conventionally.

[0027] Drawing 6 (a), (b), (c), and (d) show the 2nd operation gestalt of this invention three dimentional display equipment, and drawing 7 (a), (b), and (c) show opening used in drawing 6 (a), (b), and (c), respectively. In addition, drawing 6 (a), (b), (c), and (d) are include-angle thetaO set to -3 phi<=theta O-thetaR0 <=3phi according to this operation gestalt. The body light which it has is reproduced and it is explaining that viewing area expansion is realized.

[0028] Drawing 6 (a), (b), and (c) explain the case where only zero-order [primary] and the primary [-] true image (real image) are reproduced with above-mentioned opening and an above-mentioned gobo, respectively here. That is, drawing 6 (a) is include-angle thetaO used as phi<=theta O-thetaR0 <=3phi generated from the point on a body. Playback of the body light which it has, Drawing 6 (b) is include-angle thetaO used as - phi<=theta O-thetaR0 <=phi generated from the point on a body. Playback of the body light which it has, and drawing 6 (c) are include-angle thetaO used as -3 phi<=theta O-thetaR0 <=-phi generated from the point on a body. The configuration which reproduces body light which it has is **********(ed). Moreover, in order to remove active jamming by the light which participates in the image formation of a conjugate image, in each configuration of drawing 6 (a), (b), and (c), combination with a technique given in a Japanese-Patent-Application-No. 10-No. 81680 specification is used.

[0029] It explains to a detail. Here, distance between the point on a body and the interference fringe creation side 1 is set to d. Drawing 6 (a) displays the interference fringe which does not contain the clinch component created by the reference beam of thetaR =thetaR0 after making the dtan2phi migration of the location of the point on a body do in the direction of a vertical on the interference fringe screen 2. By considering as opening of the same magnitude as the passage field of a zero-order light centering on the image formation point of the primary transmitted light which shows the opening 4 arranged to the image side focal plane of a lens 3 in drawing 7 (a), and arranging the still smaller gobo to an opening core Include-angle thetaO used as phi<=theta O-thetaR0 <=3phi generated from the point on the beam of light which participates in the image formation of the primary true image of the reproduced true image (real image), i.e., a body, It is shown that only the body light which it has is reproduced.

[0030] Moreover, drawing 6 (b) is include-angle thetaO used as - phi<=theta O-thetaR0 <=phi generated from the point on a body. The interference fringe which does not contain the clinch component created by the reference beam of thetaR =thetaR0 to the body light which it has is displayed on the interference fringe screen 2. By considering as opening of the same magnitude as the passage field of a zero-order light centering on the image formation point of the zero-order transmitted light which shows the opening 4 arranged to the image side focal plane of a lens 3 in drawing 7 (b), and arranging the still smaller gobo to an opening core Include-angle thetaO used as - phi<=theta O-thetaR0 <=phi generated from the point on the beam of light which participates in the image formation of the zero-order true image of the

reproduced true image (real image), i.e., a body, It is shown that only the body light which it has is reproduced.
[0031] Moreover, drawing 6 (c) displays the interference fringe which does not contain the clinch component created by the reference beam of thetaR =thetaR0 after making the -dtan2phi migration of the location of the point on a body do in the direction of a vertical on the interference fringe screen 2. By considering as opening of the same magnitude as the passage field of a zero-order light centering on the image formation point of the primary [-] transmitted light which shows the opening 4 arranged to the image side focal plane of a lens 3 in drawing 7 (c), and arranging the still smaller gobo to an opening core Include-angle thetaO used as -3 phi<=theta O-thetaR0 <=-phi generated from the point on the beam of light which participates in the image formation of the primary [-] true image of the reproduced true image (real image), i.e., a body, It is shown that only the body light which it has is reproduced.
[0032] All the true images (real image) reproduced with the configuration (drawing 6 (a), (b), (c)) of each above are in agreement with the true image (real image) equivalent to the location of the point on an original body. Then, by switching the interference fringe which switches the configuration of drawing 6 (a), (b), and (c) by time sharing, namely, is displayed on the interference fringe screen 2 by time sharing, and switching opening 4 synchronizing with a switch of an interference fringe, it is visible as if each body light reproduced by time sharing occurred to people's eyes at coincidence, as shown in drawing 6 (d), and a viewing area will be expanded by about 3 times.
[0033] Although this operation gestalt (2nd operation gestalt) explained the case where the interference fringe which considered as the interference fringe to which image formation of the high order true image is carried out, was made to move a body location, and was created and which does not contain a component by return was used next, two kinds of methods of obtaining an interference fringe equivalent to this are explained.
[0034] First, the 1st approach is explained. Drawing 8 shows the 1st approach other than the above for creating the interference fringe to which image formation of the high order true image is carried out. Include-angle thetaO set to phi<=theta O-thetaR0 <=3phi generated from the point on a body as shown in drawing 8 If the body light which it has, and the reference beam which has the include angle of thetaR0+2phi are made to interfere, include-angle |thetaO-(thetaR0+2phi) | which body light and a reference beam make becomes below phi, and can create the interference fringe which does not contain a component by return. If it displays on the interference fringe screen 2 shown in drawing 4 which mentioned this interference fringe above and a hologram image is reproduced with the playback light 5 of the include angle of thetaR =thetaR0, a zero-order true image (virtual image) will be reproduced by the location which shifted only dsin 2 phi**dtan 2 phi from the location of the point on an original body in the direction of a vertical with the distance d with the interference fringe screen 2.
[0035] The image formation location of the primary true image [as opposed to / this is the same as the 1st operation gestalt of this invention mentioned above, and / a zero-order true image (real image)] (real image) original -- a body -- a top -- a point -- a location -- corresponding -- a true image (virtual image) -- from -- phi<=theta -- O - theta -- R -- zero -- <= -- three -- phi -- light -- a lens -- three -- image formation -- carrying out -- having had -- a real image -- a location -- in agreement -- the -- one -- operation -- a gestalt -- the same -- a body -- a top -- a point -- from -- generating -- | -- theta -- R - theta -- O -- | -- > -- phi -- becoming -- an include angle -- theta -- O The body light which it has is reproduced.
[0036] Next, the 2nd approach is explained. Include-angle thetaO here set to phi<=theta O-thetaR0 <=3phi generated from the point on a body The case where the interference fringe which has the clinch component created by the reference beam of thetaR =thetaR0 to the body light which it has is displayed on the interference fringe screen is considered. First the clinch component of this interference fringe In the case of phi<=theta O-thetaR0 <=2phi The fringe spacing of the interference fringe obtained when the include angle which body light and a reference beam make is 2phi- (theta O-theta R0), That is, it becomes the same as the fringe spacing of the interference fringe which was created by interference with the reference beam of thetaR =thetaR0+2phi to the same body light (when the include angle which body light and a reference beam make is (2 phi+theta R0)-thetaO) and which does not contain a component by

return.
[0037] moreover, in 2 phi<=theta O-thetaR0 <=3phi Become the fringe spacing of the interference fringe obtained when the include angle which body light and a reference beam make is thetaO- (2 phi+theta R0). That is, it becomes the same as the fringe spacing of the interference fringe which was created from interference with the reference beam of thetaR =thetaR0+2phi to the same body light (when the include angle which body light and a reference beam make is thetaO- (2 phi+theta R0)) and which does not contain a component by return. That is, it becomes the interference fringe and equivalence which were created by the 1st approach (refer to drawing 8) mentioned above in this case. Therefore, the playback from this interference fringe is include-angle thetaO which becomes the same as having been shown in drawing 4 , and is set to |thetaR-thetaO |>phi generated from the point on a body. The body light which it has is reproduced.
[0038] Although the 2nd operation gestalt (drawing 6 , 7 reference) of this invention three dimentional display equipment mentioned above explained as what switches three configurations by time sharing, this is not necessarily restricted to three and can be made into the number of arbitration. A viewing area can be increased 9 times two-dimensional by specifically extending perpendicularly similarly horizontally composition of the perpendicularly it is shown in drawing 6 . If the number of configurations is set to m, the range where the body light reproduced spreads, i.e., a viewing area, will be expanded by m times. However, increasing the number of configurations will use the image of a higher degree, and since the difference of light and darkness with a zero-order image is as large as the image of a high degree, it needs to avoid it and needs to equalize the brightness of the body light reproduced between the images of each degree.
[0039] How to, make small the numerical aperture in the sampling structure of the interference fringe screen of equalization as law on the other hand can be considered. It is a thing using a high order image being relatively generated strongly by narrowing width of face of the opening part of the grid of a diffraction grating in this approach (the whole quantity of light decreasing by having made the numerical aperture small). In order to compensate reduction of the whole quantity of light by having made small the difference of light and darkness with the zero-order image of a high order image, having had it by making the numerical aperture of the interference fringe screen small, and having equalized brightness between the images of each degree, and having made the numerical aperture small, a bright beam of light is used for playback light. Moreover, covering ND (Neutral Density) filter over opening according to the adaptive control of the playback light of changing the quantity of light of playback light to playback of a high order image according to the brightness of a reconstruction image and the brightness of playback light etc. is considered.
[0040] Moreover, as a display device which uses an interference fringe for the interference fringe screen switched at high speed, space light modulation elements, such as a liquid crystal display panel, can be used. Moreover, a switch of opening arranges an independently controllable shutter to each opening, and should just perform switching operation of these shutters. A thing [****] like a mechanical shutter and liquid crystal shutter can be used for a shutter.
[0041] Next, in the operation gestalt of this invention three dimentional display equipment mentioned above, the body light from each interference fringe is reproduced by time sharing, and to having made it compound using seeming to have generated to people's eyes at coincidence, it reproduces the body light from each interference fringe to coincidence, and, below, explains the 3rd operation gestalt compounded spatially with reference to drawing 9 . In addition, drawing 7 (a) which shows each opening used when compounding the body light from each above-mentioned interference fringe by time sharing, (b), and (c) are referred to here.
[0042] Drawing 9 shows the 3rd operation gestalt of this invention three dimentional display equipment. Three interference fringe screen 2a when this operation gestalt has the same sampling structure and a sampling interval as shown in drawing 9 , 2b, 2c, Three lenses 3a, 3b, and 3c which have the same focal distance, the openings 4a, 4b, and 4c arranged to the image side focal plane of each lens, It consists of playback light 5a, 5b, and 5c which has whenever [same incident angle] to each interference fringe screen on the same wavelength, and half mirrors 6a and 6b, and each lenses 3a, 3b, and 3c are arranged

so that the optical axis of these lenses may be in agreement after compounding by half mirrors 6a and 6b. Include-angle thetaO set to -3 phi<=theta O-thetaR0 <=3phi by the above configuration The body light which it has is reproduced and viewing area expansion is realized.

[0043] It explains to a detail. Include-angle thetaO set to phi<=theta O-thetaR0 <=3phi generated from the point on a body in drawing 9 at interference fringe screen 2a The interference fringe which was made to move a body location to the body light which it has, or was created by the reference beam of theta R=theta R0+2phi and which does not contain a component by return, or the interference fringe which was created by the reference beam of thetaR =thetaR0 and which consists of a component by return is displayed. By using opening 4a as opening of the same magnitude as the passage field of a zero-order light centering on the image formation point of the primary transmitted light shown in drawing 7 (a), and arranging the still smaller gobo to an opening core Include-angle thetaO used as phi<=theta O-thetaR0 <=3phi generated from the point on the beam of light which participates in the image formation of the primary true image (real image) reproduced by playback light 5a of the include angle of thetaR =thetaR0, i.e., a body, Only the body light which it has is reproduced.

[0044] Moreover, include-angle thetaO used as - phi<=theta O-thetaR0 <=phi generated from the point on a body in interference fringe screen 2b The interference fringe which was created by the reference beam of thetaR =thetaR0 to the body light which it has and which does not contain a component by return is displayed. By using opening 4b as opening of the same magnitude as the passage field of a zero-order light centering on the image formation point of the zero-order transmitted light shown in drawing 7 (b), and arranging the still smaller gobo to an opening core Include-angle thetaO used as - phi<=theta O-thetaR0 <=phi generated from the point on the beam of light which participates in the image formation of the zero-order true image (real image) reproduced by playback light 5b of the same include angle as the reference beam of thetaR =thetaR0, i.e., a body, Only the body light which it has is reproduced.

[0045] Moreover, include-angle thetaO set to -3 phi<=theta O-thetaR0 <=-phi generated from the point on a body at interference fringe screen 2c The interference fringe which was made to move a body location to the body light which it has, or was created by the reference beam of thetaR =thetaR0-2phi and which does not contain a component by return, or the interference fringe which was created by the reference beam of thetaR =thetaR0 and which consists of a component by return is displayed. By using opening 4c as opening of the same magnitude as the passage field of a zero-order light centering on the image formation point of the primary [-] transmitted light shown in drawing 7 (c), and arranging the still smaller gobo to an opening core Include-angle thetaO used as -3 phi<=theta O-thetaR0 <=-phi generated from the point on the beam of light which participates in the image formation of the primary [-] true image (real image) reproduced by playback light 5c of the include angle of thetaR =thetaR0, i.e., a body, Only the body light which it has is reproduced.

[0046] A viewing area is expanded by about 3 times by compounding spatially each body light reproduced by the above by half mirrors 6a and 6b.

[0047] Although the 3rd operation gestalt of this invention three dimentional display equipment mentioned above explained as an example as what compounds the body light of three fields spatially, similarly in the 1st or 2nd operation gestalt, this is not necessarily restricted to three fields and can be made into the number of arbitration. Specifically, a viewing area can be increased 9 times two-dimensional by extending composition of the perpendicular direction of drawing 9 horizontally perpendicularly similarly. If the number of fields is set to m, the range where the body light reproduced spreads, i.e., a viewing area, will be expanded by m times. However, like in the 1st or the 2nd operation gestalt in this case, increasing the number of fields will use the image of a higher degree, and the difference of light and darkness with a zero-order image is as large as the image of a high degree. Then, it is desirable to use together the approach of using a bright light for the playback light 5, in order to make small the numerical aperture in the sampling structure of the interference fringe screen 2 in order to equalize the difference of light and darkness between the images of each degree, and to compensate reduction of the whole quantity of light in such a top, and changing the quantity of light of the playback light 5 to playback of a high order image according to the brightness of a reconstruction image.

[0048] Moreover, although space light modulation elements, such as a liquid crystal display panel, can be used as a display device used for the interference fringe screen similarly in the 1st or 2nd operation gestalt in this operation gestalt (3rd operation gestalt) When reproducing a hologram image by the animation, the switch rate of the interference fringe screen required of this operation gestalt in order to acquire the reconstruction image which has the same time amount property as the reconstruction image by the 1st or 2nd operation gestalt When the number of the fields of the body light compounded is set to m, it is good at the twice (1/m) of the switch rate of the interference fringe screen in the 1st or 2nd operation gestalt.

[0049] This invention three dimentional display equipment is not restricted to the 1st [which was explained above] thru/or 3rd operation gestalt, and within the publication of a claim, carrying out combining each of these operation gestalten suitably etc. can carry out various deformation, and can carry it out.

[0050]

[Effect of the Invention] This invention can be made to perform expansion of a viewing area, without [without it enlarges resolution of the interference fringe screen by using the light which participates in the image formation of the high order image to the reproduced true image (virtual image), and] changing the magnitude of a true image (virtual image). Therefore, according to this invention, also when a liquid crystal display panel with pixel spacing coarse as the interference fringe screen is used, the large hologram image of a viewing area can be reproduced and it becomes a technique effective in animation holography equipment etc.

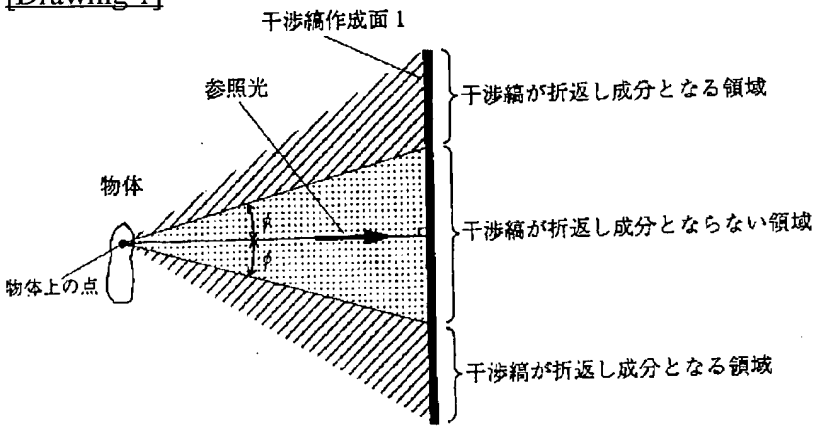
[Translation done.]

* NOTICES *

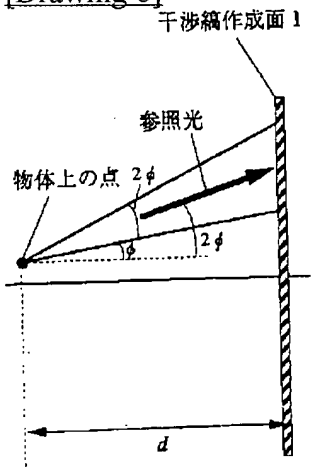
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

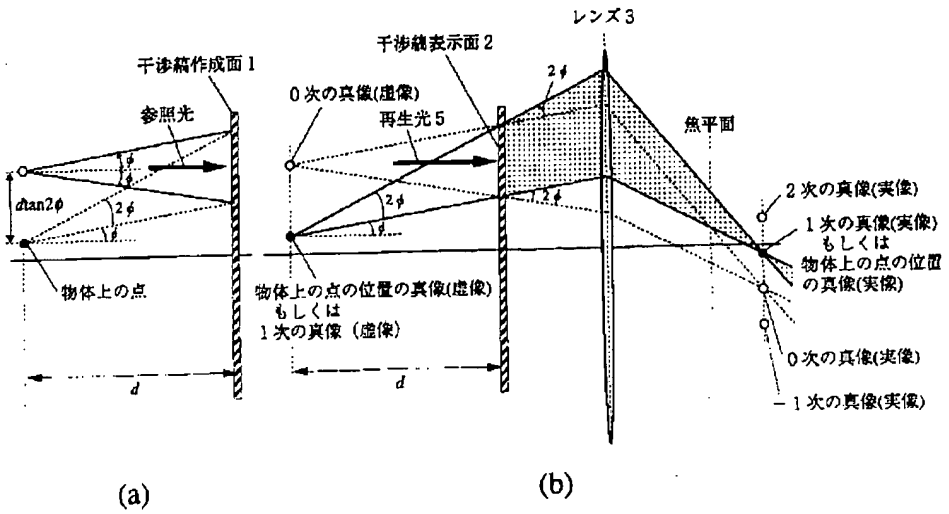
[Drawing 1]



[Drawing 8]

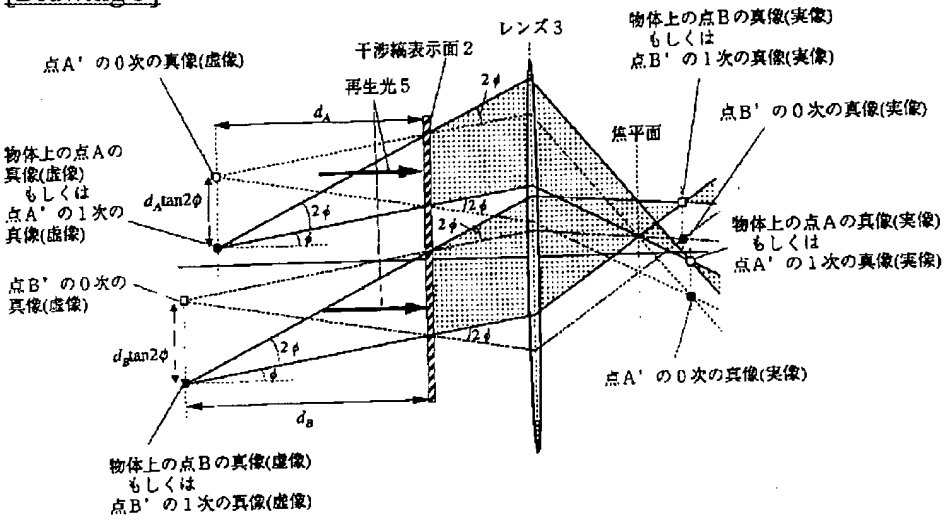


[Drawing 2]

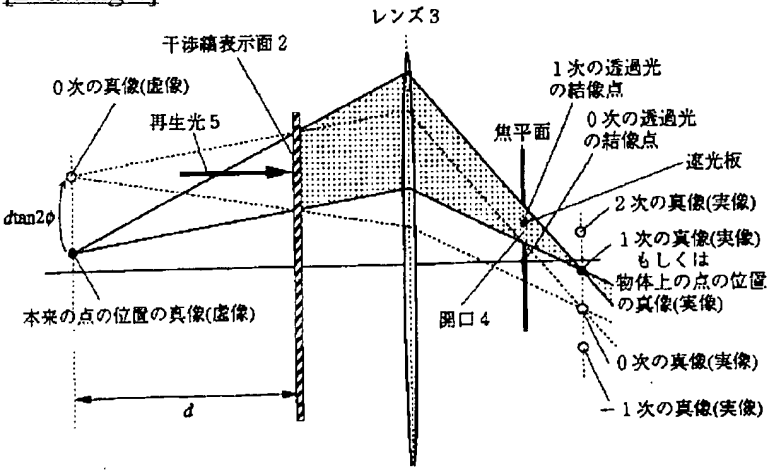


(a) (b)

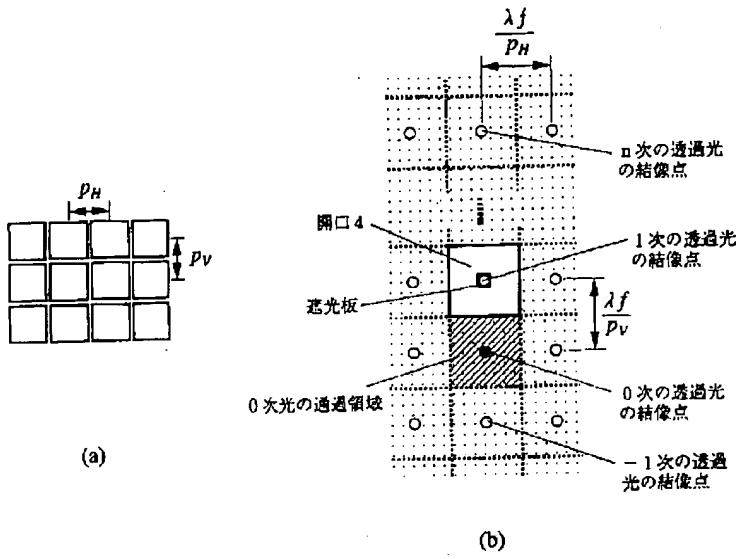
[Drawing 3]



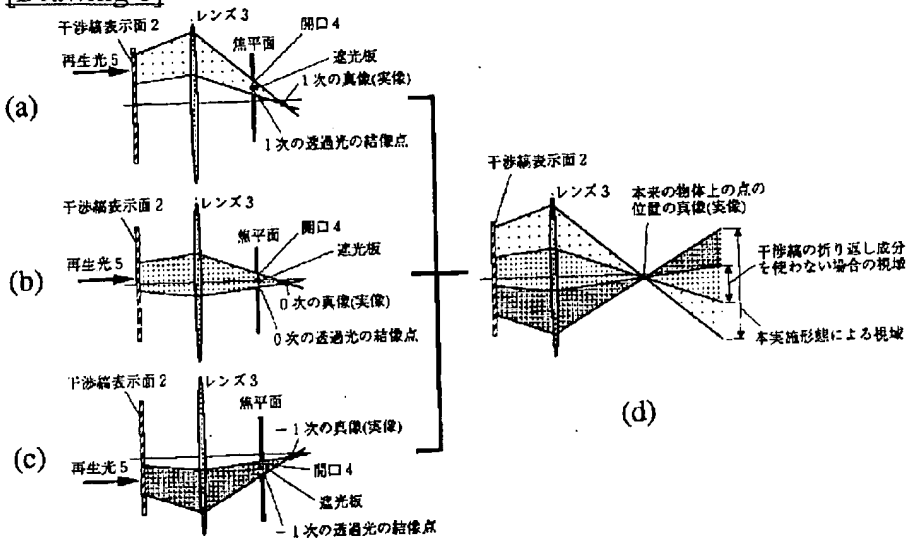
[Drawing 4]



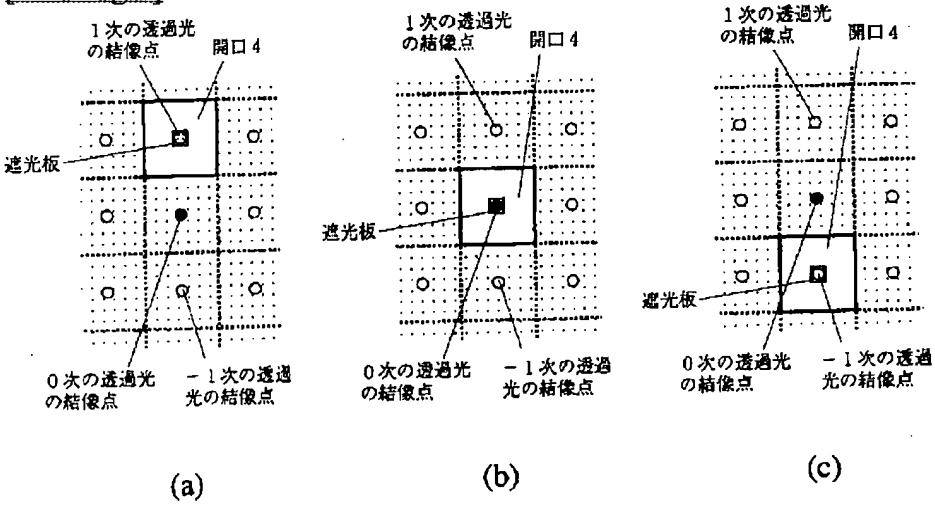
[Drawing 5]



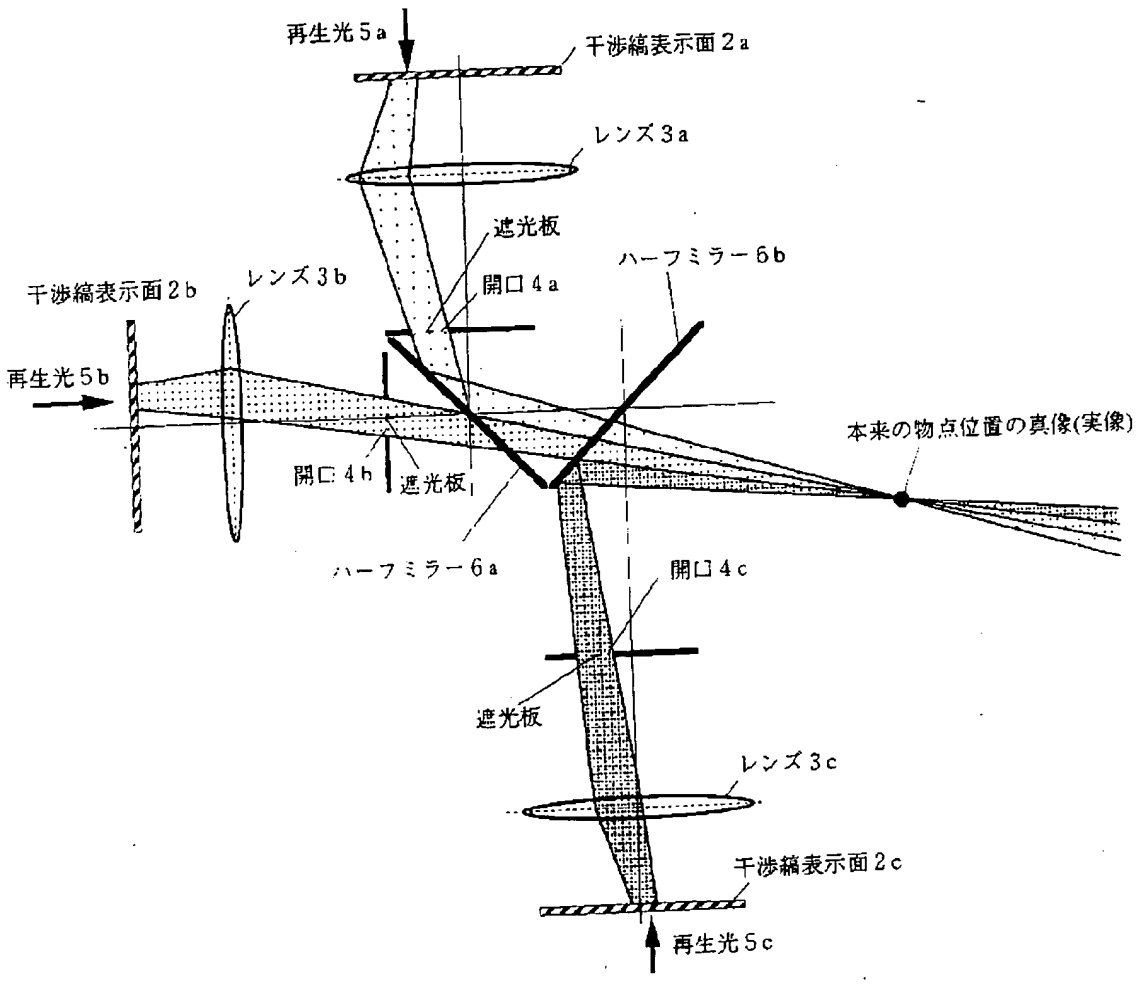
[Drawing 6]



[Drawing 7]



[Drawing 9]



[Translation done.]